Compression systems are designed for the governing process conditions. In the Oil and Gas industry, these conditions are often dynamic and a function of reservoir or field characteristics which have varying head and flow rate requirements throughout the field life. The main application objective when designing a gas turbine driven centrifugal compression solution to suit these applications, is to maximize efficiency while minimizing the requirement for additional package modifications or major capital works in mid to late field life. This presentation shows how these objectives were achieved for a case example in South Sumatra, Indonesia where an onshore gas field, feeds a localized gas plant that requires front end compression.
Adapting compression equipment to accommodate declining well pressures and ensure overall efficiency in mid/late field life.

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Declining well head pressure, drives the requirement for front end compression to maintain plant operation and maximum gas export.
How do you select turbomachinery equipment for the following conditions?

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>UNITS</th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
<th>Case 4</th>
<th>Case 5</th>
<th>Case 6</th>
<th>Case 7</th>
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<tbody>
<tr>
<td>Time Period</td>
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<td>24 to 36 Months</td>
<td>24 to 36 Months</td>
<td>60 Months</td>
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<td>Suction Pressure (P1)</td>
<td>[psia]</td>
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<td>Suction Temperature (T1)</td>
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<tr>
<td>Discharge Pressure (P2)</td>
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<tr>
<td>Station Flow (Equiv. Q)</td>
<td>%</td>
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<td>90%</td>
<td>91%</td>
<td>77%</td>
<td>55%</td>
<td>41%</td>
<td>32%</td>
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<tr>
<td>Inlet Flow</td>
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<td>4120</td>
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<td>10196</td>
<td>13868</td>
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<td>Head (isen)</td>
<td>[ft-lbf/lbm]</td>
<td>16929</td>
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<td>48462</td>
<td>49719</td>
<td>84806</td>
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<td>Gas Composition</td>
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<td>0.847</td>
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</tr>
</tbody>
</table>

Main Objectives/Considerations:

Maximize Efficiency
Minimize Onsite Rework
Cost (CAPEX & OPEX)
High Reliability and Availability
Constructability / Remote Location
Maximize Output/Production
- Total Power Required
- Package Configuration
- Redundancy
- Turndown
- Fuel Efficiency
- Power Margin
- Performance Degradation
- Emission Requirements
- Speed Range
- Combustion System
The Solution

- 3 x Package Configuration
- Gas Turbine – 10,300 HP (ISO)
- Speed Increasing Gearbox
- Expandable Multi Body Compression System
- Flexible Process Cooler & Plant
- Late Life Rerate Flexibility

Phase One: Gas Turbine - GB - LP
Phase Two: Gas Turbine - GB - LP - IP
Phase Three: Gas Turbine - GB - LP - IP - HP
- Gas Turbine - 10,300 HP (ISO)
- 3 x Package Configuration
  - Phase 1 – 3 x 50% Operation
  - Phase 2 – 3 x 33% Operation
  - Phase 3 – 3 x 33% Operation
- Adequate Power Margin
- High Part Load Efficiency
- Uprate Option during O/H Cycle
- Engine Commonality in Fleet
- Compliant Emissions
Phase One:
- 3 x 50% Operation
- Gas Turbine – GB – LP
- Discharge Pressure: 1315 PSIG
- Suction Pressure: 800 - 385 PSIG
Phase Two:
- 3 x 33% Operation
- Gas Turbine – GB – LP - HP
- Discharge Pressure: 1315 PSIG
- Suction Pressure: 385 - 110 PSIG
Phase Three:
- 3 x 33% Operation
- Gas Turbine – GB – LP – IP – HP
- LP & IP Compressors Restaged
- Discharge Pressure: 1315 PSIG
- Suction Pressure: 110 - < 70 PSIG
- Complete package designed, manufactured and tested by single OEM
- IP and HP compressor package systems including lube oil piping, seal gas, wiring and instrumentation preinstalled and tested ready for activation during Phase 2 & 3
- Isolation and preservation measures implement for inactive components on Phase 1
- CAPEX for IP and HP compressors deferred until Phase 2 & 3
- Preconfigured package control software designed, tested and preloaded for all Phases
- Surge control system preconfigured for all Phases
- Process cooler designed for maximum cooling load with turndown capability for Phase 1 & 2
- Process piping designed with manifold and tie in points for Phase 2 & 3
- Yard valve selected to operate under full range of operating conditions
- Initial suction scrubber installation suitable for all Phases
3 x Package Configuration

- Provided better efficiency, turn down and operability throughout field life.
- Achieved redundancy and availability objectives for contract output requirements
- Package size met constructability requirements and drove common configuration with existing fleet

Preconfigured Package and Addition of Compressor Bodies for Each Phase

- Greater overall field life efficiency and operating flexibility
- Flexibility on timing of transition to Phase 2 & 3
- Deferred CAPEX for procurement of IP & HP compressors
- Reduced downtime during conversion to Phase 2 & 3

Preconfigured Plant Design

- Adaptable to compression system with minimum downtime during conversion to Phase 2 & 3
- Minor project works only